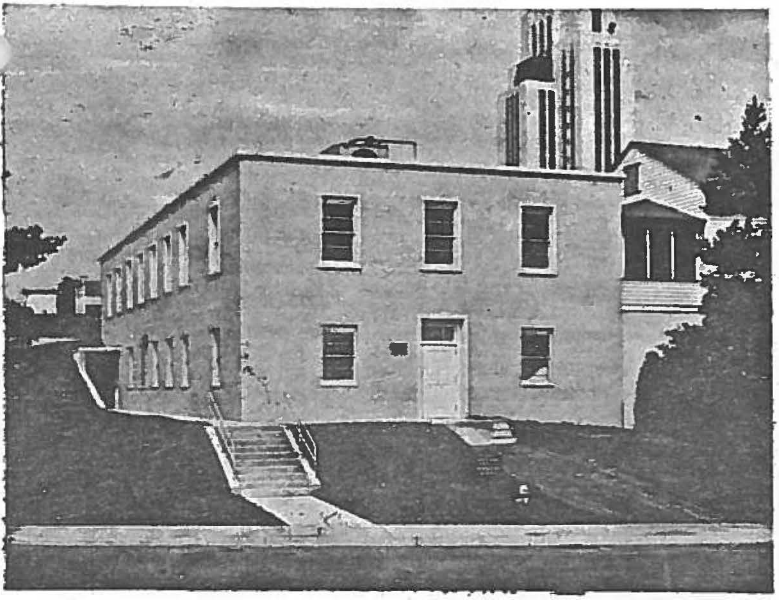
RADIATION EXPOSURE EVALUATION LABORATORY

U. S. NAVAL HOSPITAL
NATIONAL NAVAL MEDICAL CENTER
BETHESDA, MARYLAND



THE RADIATION EXPOSURE EVALUATION LABORATORY

Captain E. Richard King, MC, USN
Chief of Radiology
U. S. Naval Hospital

Captain J. S. Burkle, MC, USN
Director, Radiation Exposure Evaluation Laboratory
U. S. Naval Hospital

Captain G. L. Lewis, MC, USN
Head, Nuclear Medicine Branch
U. S. Naval Hospital

AN HISTORICAL RECORD OF THE RADIATION EXPOSURE EVALUATION LABORATORY

DEPARTMENT OF RADIOLOGY
U. S. NAVAL HOSPITAL
BETHESDA, MARYLAND

The sources of exposure of Naval personnel to ionizing radiation have been increasing over the past several years. The need for a center to evaluate individuals suspected of exposure to radiation or to manage and treat patients actually exposed has become more and more apparent. In February 1957, Rear Admiral B. W. Hogan, MC, USN, the Surgeon General, requested advice on this matter from several sources. Among those consulted were Doctors William Looney and Norman Rassmussen of the Massachusetts Institute of Technology. They recommended a minimum of one shielded room for whole-body counting. At the request of the Surgeon General, and in order to study this problem, the Commanding Officer of the National Naval Medical Center, Rear Admiral T. F. Cooper, MC, USN, appointed a committee with Captain R. B. Williams, MC, USN, as chairman.

After several weeks of effort, the committee recommended that a separate building be erected and placed under the administration of the Department of Radiology. This unit would function as a center for the care and management of the radiation patient. In order to present this proposal to Congress without delay, a crash program was instituted under the direction of the Planning Division (Captain E. C. Stone, MC, USN) and the Special Weapons Defense Division (Captain P. F. Dickens, MC, USN) of the Bureau of Medicine and Surgery.

The original proposal called for a three-story building, the top floor to be devoted to patient care, with ground and second floors to be reserved for laboratories. Also on the ground floor were to be four steel rooms for whole-body counting. This proposal was modified somewhat in June 1959. Congress appropriated approximately $750,000 to finance the building which was named the Radiation Exposure Evaluation Laboratory (REEL).

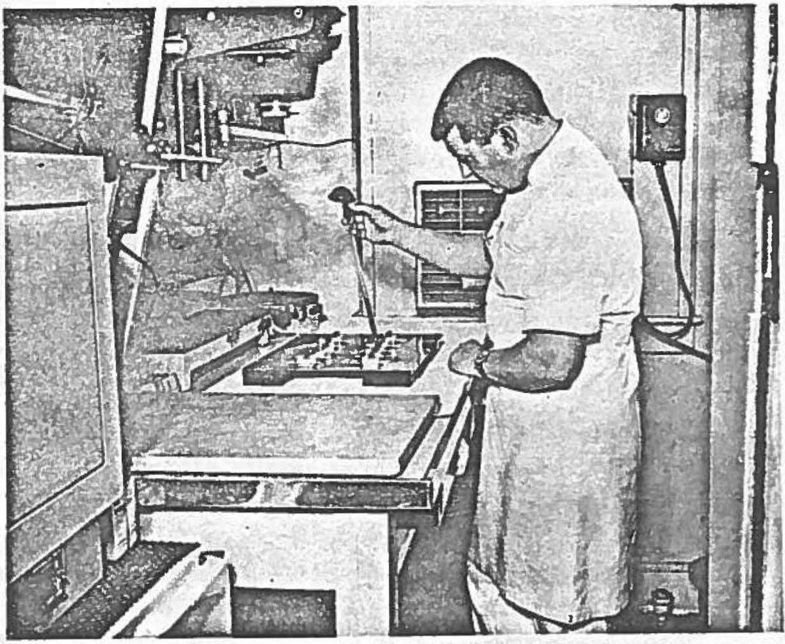
The contract for construction was awarded to the American Construction Company, Washington, D.C., and excavation was started 12 August 1959. The steel for the shielded rooms was obtained from the Naval Ordnance Plant, South Charleston, West Virginia. This was pre-1945 steel, having been fabricated for armor plate prior to the first nuclear weapon detonation at Frenchman's Flat. New steel was believed to be contaminated with radioactive material and, therefore, not satisfactory to shield the sensitive whole-body counters from background radiation, including rays from earth and from cosmos. The steel was machined to plates 8 feet square and 4 inches thick. Two of these plates were then fastened together back to back to provide 8-inch shielding. Each of these plates weighed 16 tons and the total of 21 plates required weighed nearly 350 tons. The entrance doors to each of the four steel rooms were fabricated by a firm specializing in the construction of bank vaults.

The 16-ton armor plate partitions being placed in the basement of the REEL building.

The building was completed on 15 July 1960 and occupancy was begun during August.

Three patient rooms are available for the care required by those who have received high doses of ionizing radiation. It is planned that, if feasible, one of the rooms will be converted to a near "germ-free" room in order to minimize chances of infection in these susceptible patients.

The laboratory is manned by a team of physicians, nurses, physicists and technicians and can furnish complete care, including required laboratory studies, to radiation patients. A surgery is located on the second floor where minor surgical procedures can be carried out if the patient has been exposed to thermal or mechanical trauma, as well as to radiation. Surgeons and other specialists on the staff of the U. S. Naval Hospital can be called upon for consultation.

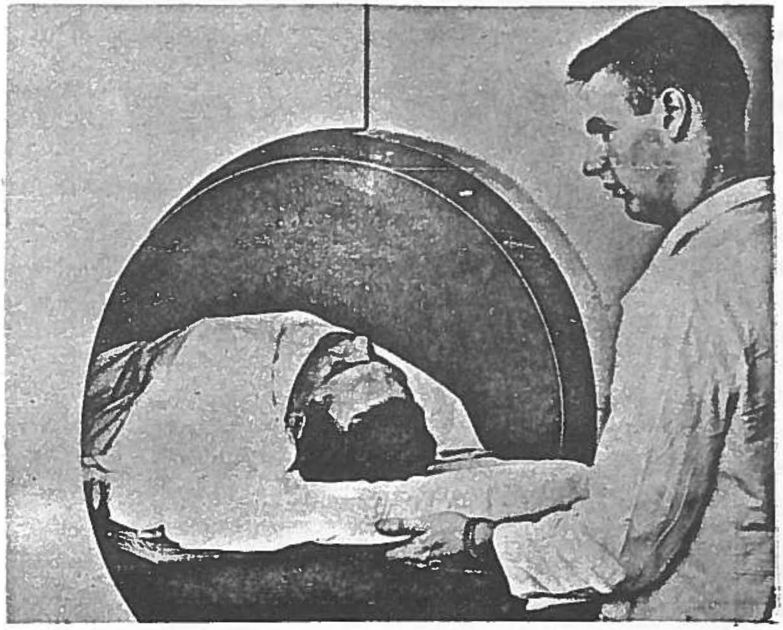


A scene in the radiohistology laboratory.

In order to maintain the efficiency of the staff of the REEL, as well as to develop new techniques of diagnosis and management of the radiation patients, several projects utilizing the laboratory are planned or under way. Examples of such projects are:

1. Total-body radiation therapy of acute leukemia and of certain advanced cases of cancer utilizing the Naval Medical Research Institute's cobalt-60 irradiator. (See print)
2. Bone marrow transplants in certain patients treated with total-body radiation.
3. Studies of methods of bone marrow preservation and feasibility of establishing a "bone marrow bank." *
4. Chromosomal observations in humans.*
5. Changes in urinary excretion of certain amino acids following total-body radiation.
6. Changes in the fibrinolytic system following total-body radiation.
7. Enzyme system changes following total-body radiation.
8. The use of the shielded steel rooms in clinical radioisotope studies.
9. A study of the radioactive elements in animals exposed to neutron radiation. This may aid in determining the neutron dose received by certain patients.
10. Whole-body counting of normal individuals and of Naval personnel environmentally exposed to ionizing radiation.

*These two studies are being performed in conjunction with the Tissue Bank Department, Naval Medical School.



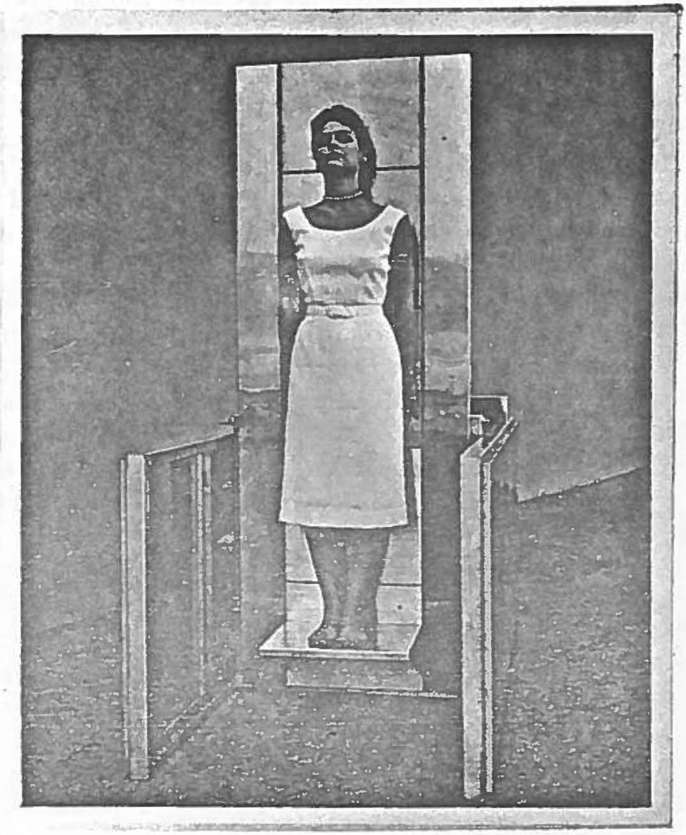
The NMRI Co^{60} irradiator used for total-body radiation therapy.

WHOLE-BODY COUNTING

Although the concept of a facility devoted entirely to radiation disaster cases is not new, the REEL establishment is the most complete and self-contained of any such facility. One unique design is that of four steel rooms to be used for low radiation background whole-body counting.

Two rooms will be equipped with very sensitive radiation detectors that measure the extremely low levels of two radioactive materials that are present in all humans. These two radioisotopes are natural radiopotassium (K^{40}) which is present wherever the element potassium is found, and a contaminant, radiocesium (Cs^{137}) which is in the bodies of all living creatures. This is a fission product produced by fallout. It is also possible to measure other radioactive materials in humans that might have gained entry into the body as the result of a nuclear accident, or by environmental exposure. In addition, if the body is exposed to neutrons, some of the elements in the body become radioactive. These "induced" radioisotopes may be determined by whole-body counting both qualitatively and quantitatively. Determinations of this type will indicate the dose of radiation received by the patient and will assist the clinician in treating victim

The two rooms mentioned above will serve separate purposes. One will be less sensitive, measuring the total radioactivity present, but separating this radioactivity by only a rough method into its different components. This is the "quick and dirty" room where, in a matter of a few minutes it will be determined whether or not the patient has any abnormal radioactivity in his or her body.



The whole-body counter.

The other room will determine the total amount present, the types of radioactivity, and the locations of these radioactive contaminants within the body of the patient. This process may take 30 to 60 minutes.

Results of whole-body counting will be "read out" on various types of recording devices and will be prepared so that these results can be analyzed at a later date by a data processing device.

These sensitive detectors will require complete external decontamination of the patient before entry into the steel rooms. Thus, all personnel to be counted, as well as those working in the area, will require a meticulous shower and shampoo and must don special clothing in order to eliminate any radioactive material that may be clinging to the exterior of their bodies.

It is planned to establish normal values by examining in this manner several hundred normal people of all age groups and of both sexes. Extensive statistical processing will be required for this analysis.

One of the steel rooms is near an external entrance into the building and will be maintained as a "non-decontamination" area. Patients who are to have radioisotope studies will be brought into this room without showering. By using a steel room, it is hoped that the dose of a radioisotope required for a clinical study and counting may be reduced by a factor of 10 or more. In addition, studies that ordinarily require the collection of excreta may be performed in the steel room by whole-body counting of the radioactive material remaining in the patient. Such studies as the Schilling test for pernicious anemia, iron metabolism and the fat studies for pancreatic function could be performed more easily.

Student nuclear nurses examine a brain tumor scanner.